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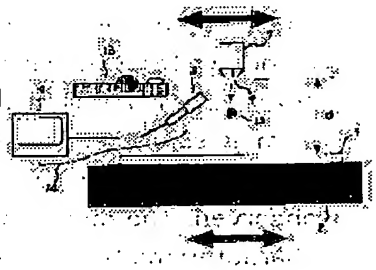
(54) MANUFACTURE OF ELECTRON SOURCE SUBSTRATE, MANUFACTURE OF IMAGE FORMING DEVICE, MANUFACTURING DEVICE FOR THE ELECTRON SOURCE SUBSTRATE AND MANUFACTURING DEVICE FOR THE IMAGE FORMING DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a uniform surface conductive type electron emission element by correctly, surely and easily forming uniform element electrodes and a conductive thin film on a large area at a low cost.

SOLUTION: A droplet application device used for this manufacturing method of an electron source substrate is provided with a head cleaning mechanism 13 and a head surface observation mechanism 14. In this case, at first abutting a sucking pad on the tip of the spouting head 7 for sucking a suitable amount of ink (a metal containing solution) in a nozzle 9 of a spouting head 7 is sucked to refresh the ink at the tip part of the nozzle. Then, wiping cloth is abutted on the tip of the spouting head 7 and thereafter moved, so that the ink and foreign matters stuck to the surface and circumference of the nozzle 9 are wiped off. Thereafter, whether or not there is any problem is confirmed by observing dirt, damage and the adhesion of foreign matters on the surface of the spouting head 7, and the clogging state of the ink after the cleaning.



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CLAIMS

[Claim(s)]
[Claim 1] On an insulating substrate, it has the component electrode of a pair, and the conductive thin film which connects said each component inter-electrode. The electron emission component which comes to form the electron emission section to said some of conductive thin films is the manufacture approach of the electron source substrate which comes to carry out two or more arrays, and it faces forming said conductive thin film at least. The manufacture approach of the electron source substrate characterized by being characterized by carrying out discharge grant of said solution on the component electrode concerned which contains said each component inter-electrode as a drop from said discharge head after defecating at least the point of the discharge head which carries out the regurgitation of the solution containing a metallic element.
[Claim 2] On an insulating substrate, it has the component electrode of a pair, and the conductive thin film which connects said each component inter-electrode. The electron emission component which comes to form the electron emission section to said some of conductive thin films is the manufacture approach of the electron source substrate which comes to carry out two or more arrays, and it faces forming said conductive thin film at least. Act as the monitor of the surface state like the point of the discharge head which carries out the regurgitation of the solution containing a metallic element, and it is observed. The manufacture approach of the electron source substrate characterized by being characterized by carrying out discharge grant of said solution on the component electrode concerned which contains said each component inter-electrode as a drop from said discharge head after checking that the discharge condition is stable.
[Claim 3] On an insulating substrate, it has the component electrode of a pair, and the conductive thin film which connects said each component inter-electrode. The electron emission component which comes to form the electron emission section to said some of conductive thin films is the manufacture approach of the electron source substrate which comes to carry out two or more arrays, and it faces forming said conductive thin film at least. While defecating at least the point of the discharge head which carries out the regurgitation of the solution containing a metallic element Act as the monitor of the surface state like the point of said defecated discharge head, and it is observed. The manufacture approach of the electron source substrate characterized by being characterized by checking that the discharge condition is stable and carrying out discharge grant of said solution on the component electrode concerned which contains said each component inter-electrode as a drop from said discharge head.
[Claim 4] The manufacture approach of the electron source substrate according to claim 1 or 3 characterized by performing the regurgitation of the suitable amount of said solution to the predetermined field prepared beforehand, and stabilizing a discharge condition after defecating at least the point of said discharge head.
[Claim 5] The manufacture approach of an electron source substrate given in any 1 term of claims 1-4 characterized by being what the regurgitation of said solution using said discharge head depends on an ink jet method.
[Claim 6] The manufacture approach of the electron source substrate according to claim 5

characterized by performing the regurgitation of said solution using said discharge head in which two or more regurgitation nozzles were prepared.

[Claim 7] The manufacture approach of the electron source substrate according to claim 5 or 6 characterized by said ink jet method being a method which makes air bubbles form in said solution, and makes said solution breathe out as a drop with heat energy.

[Claim 8] The manufacture approach of an electron source substrate given in any 1 term of claims 1–7 which connect one side of each of said component electrode on said insulating substrate, consider as the direction wiring of a train, and are characterized by connecting through an insulating layer and considering another side as line writing direction wiring in case the direction wiring of a train and line writing direction wiring are arranged in the shape of a matrix through an insulating layer.

[Claim 9] The manufacture approach of the image–formation equipment which is the manufacture approach of image–formation equipment of providing the electrical–potential–difference impression means to the electron–emission component and said electron–emission component as an electron source, the emitter which emits light in response to the electron emitted from said electron–emission component, and the drive circuit which controls the electrical potential difference impressed to said electron–emission component based on an external signal, and is characterized by to manufacture said electron–emission component by the manufacture approach of an electron source substrate according to claim 1 to 7.

[Claim 10] On an insulating substrate, it has the component electrode of a pair, and the conductive thin film which connects said each component inter–electrode. The means which the electron emission component which comes to form the electron emission section to said some of conductive thin films is the manufacturing installation of the electron source substrate which comes to carry out two or more arrays, and carries out the regurgitation from a discharge head by making the solution containing a metallic element into a drop at least, The manufacturing installation of the electron source substrate characterized by having a means to control the relative position of said discharge head and said insulating substrate, and a means to defecate at least the point of said discharge head.

[Claim 11] On an insulating substrate, it has the component electrode of a pair, and the conductive thin film which connects said each component inter–electrode. The means which the electron emission component which comes to form the electron emission section to said some of conductive thin films is the manufacturing installation of the electron source substrate which comes to carry out two or more arrays, and carries out the regurgitation from a discharge head by making the solution containing a metallic element into a drop at least, The manufacturing installation of the electron source substrate characterized by having a means to check that act as the monitor of the surface state like a means to control the relative position of said discharge head and said insulating substrate, and the point of said discharge head, observe it, and the discharge condition is stable.

[Claim 12] On an insulating substrate, it has the component electrode of a pair, and the conductive thin film which connects said each component inter–electrode. The means which the electron emission component which comes to form the electron emission section to said some of conductive thin films is the manufacturing installation of the electron source substrate which comes to carry out two or more arrays, and carries out the regurgitation from a discharge head by making the solution containing a metallic element into a drop at least, A means to control the relative position of said discharge head and said insulating substrate, and a means to defecate at least the point of said discharge head, The manufacturing installation of the electron source substrate characterized by having a means to check that act as the monitor of the surface state like the point of said discharge head, observe it, and the discharge condition is stable.

[Claim 13] A means to defecate at least the point of said discharge head is the manufacturing installation of an electron source substrate given in any 1 term of claims 10–12 characterized by having the device in which perform the regurgitation of the suitable amount of said solution to the predetermined field prepared beforehand, and a discharge condition is stabilized after said defecation.

[Claim 14] The manufacturing installation of an electron source substrate given in any 1 term of claims 10–13 characterized by said discharge head being what depended on an ink jet method.
[Claim 15] The manufacturing installation of the electron source substrate according to claim 14 characterized by preparing two or more regurgitation nozzles in said discharge head.
[Claim 16] The manufacturing installation of the electron source substrate according to claim 14 or 15 characterized by preparing two or more discharge heads.
[Claim 17] The manufacturing installation of an electron source substrate given in any 1 term of claims 14–16 characterized by said ink jet method being a method which makes air bubbles form in said solution, and makes said solution breathe out as a drop with heat energy.
[Claim 18] The manufacturing installation of the image formation equipment which is a manufacturing installation possessing the electrical–potential–difference impression means to the electron emission component and said electron emission component as an electron source, the emitter which emits light in response to the electron emitted from said electron emission component, and the drive circuit which controls the electrical potential difference impressed to said electron emission component based on an external signal of image formation equipment, and is characterized by having the manufacturing installation of an electron source substrate according to claim 10 to 17.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] Especially this invention is aimed at the thing in which it comes to form the electron emission component of a surface conduction mold as an electron source about the manufacture approach of an electron source substrate, the manufacture approach of image formation equipment, the manufacturing installation of an electron source substrate, and the manufacturing installation of image formation equipment.
[0002]
[Description of the Prior Art] Conventionally, it divides roughly as an electron emission component, and two kinds of things using a thermionic emission component and a cold cathode electron emission component are known. There are a field emission mold (henceforth "FE mold"), a metal / insulating layer / metal mold (an "MIM mold" is called hereafter.), a surface conduction mold electron emission component, etc. as cold cathode electron emission component.
[0003] As an example of FE mold, what was indicated by W.P.Dyke & W.W.Dolan, "Field emission", Advance in Electron Physics, 8, 89 or (1956) C.A.Spindt, "PHYSICAL Properties of thin–film field emission cathodes with molybdenium cones", J.Appl.Phys., 47, 5248, etc. (1976) is known.
[0004] On the other hand, as an example of an MIM mold, what was indicated by C.A.Mead, "Operation of Tunnel–EmissionDevices", J.Apply.Phys., 32, 646, etc. (1961) is known.

[0005] As an example of a surface conduction mold electron emission component mold, there are some which were indicated by M.I.Elinson, Radio Eng.Electron Pys., 10, 1290, etc. (1965). A surface conduction mold electron emission component uses the phenomenon which electron emission produces for the thin film of the small area formed on the substrate by passing a current in parallel with a film surface. As this surface conduction mold electron emission component, it is SnO2 by said Elinson etc. The thing using a thin film, What is depended on Au thin film [G.Dittmer, "Thin Solid Films", 9, and 317 (1972)], In 2O3 / SnO2 What is depended on a thin film [M.Hartwell and C.G.Fonstad, "IEEE Trans.ED Conf.", and 519 (1975)], What is depended on a carbon thin film [the Araki ****, a vacuum, the 26th volume, No. 1, and 22 pages (1983)] is reported.

[0006] The component configuration of the above-mentioned M.Hartwell is typically shown in drawing 6 ((a): a top view, (b):sectional view) as a typical example of these surface conduction mold electron emission components. In this drawing, 1 is a glass base and a component electrode of a pair which is formed and becomes as mutually countered in 2 and 3 on the glass base 1. 4 is a conductive thin film, it is formed by a spatter etc. by being made from a metallic oxide, and energization processing called energization foaming to this conductive thin film 4 is performed to the pattern of H mold configuration, and the electron emission section 5 is formed in it.

[0007] this invention persons indicated the cheap and plain production technique of a surface conduction mold electron emission component by JP,8-171850,A. This technique is the approach of producing a surface conduction mold electron emission component by breathing out a metal content solution on a substrate by liquid drop-like voice, and forming the component electrodes 2 and 3 and the conductive thin film 4.

[0008] Drawing 7 is the mimetic diagram showing the drop grant equipment which breathes out the conventional metal content solution by this invention persons on a substrate, and forms the component electrode and the conductive thin film of a pair. The discharge head 7 is installed above the base 1 on the substrate stage 8, and after justifying the substrate stage 8 in the direction of an arrow head, a metal content solution is made to reach the target on discharge and a base 1 in the state of a drop 12, and is made to adhere in drawing 7 from the regurgitation nozzle 9 prepared in the discharge head 7. Then, a component electrode and a conductive thin film are formed by baking etc.

[0009] In addition, although the case where the discharge head has been arranged above a substrate is illustrated in drawing 7 , it may breathe out from the bottom, or a discharge head is arranged caudad conversely, and it arranges in a longitudinal direction, and may be made to carry out the regurgitation.

[0010]

[Problem(s) to be Solved by the Invention] By drop grant mentioned above, a component electrode and a conductive thin film can be formed easily, shortening of a production process is attained, and it becomes possible to form many surface conduction mold electron emission components in a large area for a short time.

[0011] However, in order to inhibit poor formation of a surface conduction mold electron emission component and to expect the further exact and positive formation, it is required for said conventional drop grant process to add a device.

[0012] Specifically, it waits for an improvement about the following points.

** Liquid lack ** foreign matter mixing by desiccation at the tip of a nozzle, or evaporation of a solution, plugging ** foreign matter adhesion of the nozzle by solidification of a solution, and generating of ****** by the blemish on the front face of a nozzle [0013] The purpose of this invention is offering the manufacturing installation of the manufacture approach of the electron source substrate which is low cost, and formed correctly and certainly the uniform component electrode and the conductive thin film in the large area easily, and was equipped with the electron emission component of a uniform surface conduction mold, the manufacture approach of image formation equipment equipped with this electron source substrate, and an electron source substrate, and the manufacturing installation of image formation equipment.

[0014]
[Means for Solving the Problem] The manufacture approach of the electron source substrate of this invention on an insulating substrate The component electrode of a pair, Have the conductive thin film which connects said each component inter-electrode, and the electron emission component which comes to form the electron emission section to said some of conductive thin films is the technique of coming to carry out two or more arrays, and it faces forming said conductive thin film at least. After defecating at least the point of the discharge head which carries out the regurgitation of the solution containing a metallic element, discharge grant of said solution is carried out on the component electrode concerned which contains said each component inter-electrode as a drop from said discharge head.
[0015] The manufacture approach of the electron source substrate of this invention on an insulating substrate The component electrode of a pair, Have the conductive thin film which connects said each component inter-electrode, and the electron emission component which comes to form the electron emission section to said some of conductive thin films is the technique of coming to carry out two or more arrays, and it faces forming said conductive thin film at least. It acts as the monitor of the surface state like the point of the discharge head which carries out the regurgitation of the solution containing a metallic element, and it is observed, and after checking that the discharge condition is stable, discharge grant of said solution is carried out on the component electrode concerned which contains said each component inter-electrode as a drop from said discharge head.
[0016] The manufacture approach of the electron source substrate of this invention on an insulating substrate The component electrode of a pair, Have the conductive thin film which connects said each component inter-electrode, and the electron emission component which comes to form the electron emission section to said some of conductive thin films is the technique of coming to carry out two or more arrays, and it faces forming said conductive thin film at least. While defecating at least the point of the discharge head which carries out the regurgitation of the solution containing a metallic element It acts as the monitor of the surface state like the point of said defecated discharge head, it is observed, it checks that the discharge condition is stable, and discharge grant of said solution is carried out on the component electrode concerned which contains said each component inter-electrode as a drop from said discharge head.
[0017] After one mode of the manufacture approach of the electron source substrate of this invention defecates at least the point of said discharge head, it performs the regurgitation of the suitable amount of said solution to the predetermined field prepared beforehand, and stabilizes a discharge condition.
[0018] The manufacture approach of the electron source substrate of this invention sets like 1 voice, and the regurgitation of said solution using said discharge head is based on an ink jet method.
[0019] One mode of the manufacture approach of the electron source substrate of this invention performs the regurgitation of said solution using said discharge head in which two or more regurgitation nozzles were prepared.
[0020] It is the method which the manufacture approach of the electron source substrate of this invention sets [method] like 1 voice, and said ink jet method makes air bubbles form [method] in said solution with heat energy, and makes said solution breathe out as a drop.
[0021] In case it arranges the direction wiring of a train, and line writing direction wiring in the shape of a matrix through an insulating layer, one mode of the manufacture approach of the electron source substrate of this invention connects one side of each of said component electrode on said insulating substrate, considers as the direction wiring of a train, connects through an insulating layer and considers another side as line writing direction wiring.
[0022] The manufacture approach of the image formation equipment of this invention is the technique possessing the electrical-potential-difference impression means to the electron emission component and said electron emission component as an electron source, the emitter which emits light in response to the electron emitted from said electron emission component, and the drive circuit which controls the electrical potential difference impressed to said electron emission component based on an external

signal, and manufactures said electron emission component by the manufacture approach of said electron source substrate.

[0023] The manufacturing installation of the electron source substrate of this invention on an insulating substrate The component electrode of a pair, The electron emission component which has the conductive thin film which connects said each component inter-electrode and which comes to form the electron emission section to said some of conductive thin films is equipment which comes to carry out two or more arrays. It has the means which carries out the regurgitation from a discharge head by making the solution containing a metallic element into a drop at least, a means to control the relative position of said discharge head and said insulating substrate, and a means to defecate at least the point of said discharge head.

[0024] The manufacturing installation of the electron source substrate of this invention on an insulating substrate The component electrode of a pair, The electron emission component which has the conductive thin film which connects said each component inter-electrode and which comes to form the electron emission section to said some of conductive thin films is equipment which comes to carry out two or more arrays. It acts as the monitor of the surface state like the means which carries out the regurgitation from a discharge head by making the solution containing a metallic element into a drop at least, a means to control the relative position of said discharge head and said insulating substrate, and the point of said discharge head, it is observed, and it has a means to check that the discharge condition is stable.

[0025] The manufacturing installation of the electron source substrate of this invention on an insulating substrate The component electrode of a pair, The electron emission component which has the conductive thin film which connects said each component inter-electrode and which comes to form the electron emission section to said some of conductive thin films is equipment which comes to carry out two or more arrays. The means which carries out the regurgitation from a discharge head by making the solution containing a metallic element into a drop at least, It acts as the monitor of the surface state like a means to control the relative position of said discharge head and said insulating substrate, a means to defecate at least the point of said discharge head, and the point of said discharge head, it is observed, and it has a means to check that the discharge condition is stable.

[0026] A means for the manufacturing installation of the electron source substrate of this invention to set like 1 voice, and to defecate at least the point of said discharge head has the device in which perform the regurgitation of the suitable amount of said solution to the predetermined field prepared beforehand, and a discharge condition is stabilized after said defecation.

[0027] The manufacturing installation of the electron source substrate of this invention sets like 1 voice, and said discharge head is based on an ink jet method.

[0028] The manufacturing installation of the electron source substrate of this invention sets like 1 voice, and two or more regurgitation nozzles are prepared in said discharge head.

[0029] The manufacturing installation of the electron source substrate of this invention sets like 1 voice, and two or more discharge heads are prepared.

[0030] It is the method which the manufacturing installation of the electron source substrate of this invention sets [method] like 1 voice, and said ink jet method makes air bubbles form [method] in said solution with heat energy, and makes said solution breathe out as a drop.

[0031] The manufacturing installation of the image formation equipment of this invention is equipment possessing the electrical-potential-difference impression means to the electron emission component and said electron emission component as an electron source, the emitter which emits light in response to the electron emitted from said electron emission component, and the drive circuit which controls the electrical potential difference impressed to said electron emission component based on an external signal, and is equipped with the manufacturing installation of said electron source substrate.

[0032]

[Function] In the manufacture approach of the electron source substrate of this invention, it faces

forming the component electrode and the conductive thin film of a surface conduction mold electron emission component, and at least the point of the discharge head which carries out the regurgitation of the solution containing a metallic element is defecated, it checks that act as the monitor of the surface state like the point of a discharge head, observe it, and the discharge condition is stable, or the both sides of defecation, and the observation and the check by the monitor are performed. In this case, it becomes removable [desiccation at the tip of a regurgitation nozzle, or ******] by said defecation, and by observing and evaluating the head (and nozzle) front face before and behind cleaning, it becomes possible to prevent generating of the poor regurgitation and poor formation of the component electrode by impact location gap, and a conductive thin film, and a uniform component electrode and a conductive thin film can be manufactured with the sufficient yield to a large area. And expected formation of a component electrode and a conductive thin film is certainly more correctly attained by performing the both sides of defecation, and the observation and the check by the monitor.

[0033]

[Embodiment of the Invention] Drawing 1 is the outline perspective view showing the main configurations of the image formation equipment manufactured according to this operation gestalt. In drawing 1 , image formation equipment is equipped with the anode substrate 10 and the cathode substrate 1, and is constituted, many electron emission components 15 (shown all over drawing and in a circle.) of the surface conduction mold used as an electron source are allotted in the shape of a matrix (letter of a matrix), and the cathode substrate 1 is constituted. an anode — a substrate — ten — color display — carrying out — a sake — R — G — B — ** — a fluorescent substance — a field — 18 — this — a fluorescent substance — a field — 18 — a wrap — aluminum — an ingredient — ** — having carried out — thickness — 100 — (— nm —) — extent — metal — the back — a field — 19 — glass — a base — 17 — laying under the ground — immobilization — carrying out — having — constituting — having — **** .

[0034] Furthermore, 12 is the x direction wiring, 13 is the direction wiring of y, and the rear plate with which 16 supports the cathode substrate 1, and 20 are housings which fix the anode substrate 10 and the cathode substrate 1.

[0035] Drawing 2 is the mimetic diagram showing the configuration of the electron emission component 15 of a surface conduction mold, and it is the sectional view where (a) met the top view and (b) met alternate long and short dash line A–A' in (a) among this drawing.

[0036] The electron emission component 15 is a component which comes to have the conductive thin film 4 which is connected to the component electrodes 2 and 3 and these components electrodes 2 and 3 of the pair which adjoins on a base 1 (cathode substrate 1), and has the electron emission section 5 at least in a part. The electron emission section 5 is the part which some conductive thin films 4 broke, deformed thru/or deteriorated, and was made into the high resistance condition. Moreover, since electron emission is controlled, the deposition film which uses carbon or a carbon compound as a principal component may be formed on the electron emission section 5 and the outskirts of it.

[0037] This electron emission component 15 can supply the component current If between the component electrode 2 concerned and 3, and can make an electron emit from the electron emission section 5 by impressing the electrical potential difference of 15 (V) extent between the component electrode 2 and 3 through the line writing direction electrode 12 and the direction electrode 13 of a train.

[0038] It is SiO2 which formed impurity contents, such as quartz glass and Na, in the glass which decreased in number, blue plate glass, and blue plate glass by the spatter etc. as a base 1. The ceramics, Si bases, etc., such as a glass base which carried out the laminating, and an alumina, can be used.

[0039] A common conductor material can be used as an ingredient of the component electrodes 2 and 3 which counter. the printed conductor with which this consists of a metal or a metallic oxide, glass, etc., such as metals, such as nickel, Cr, Au, Mo, W, Pt, Ti, aluminum, Cu, and Pd, or an alloy and Pd, Ag, Au and RuO2, and Pd–Ag, and In2 O3–SnO2 etc. — it can choose from semi–conductor conductor material, such as a transparence conductor and polish recon, etc. suitably.

[0040] The configuration of the component electrode spacing L, component electrode die-length W, and the conductive thin film 4 etc. is designed in consideration of the gestalt applied. Preferably, the component electrode spacing L can be made into the range of hundreds of micrometers from thousands of A, and can be made into the range of several micrometers to dozens of micrometers in consideration of the electrical potential difference more preferably impressed to component inter-electrode. Component electrode die-length W can be made into the range of several micrometers to hundreds of micrometers in consideration of the resistance of an electrode, and the electron emission characteristic. Moreover, thickness d of the component electrodes 2 and 3 can be made into the range of several micrometers from hundreds of A.

[0041] In addition, it can also consider as the configuration which carried out the laminating at the order of the conductive thin film 4 and the component electrodes 2 and 3 which counter not only the configuration shown in drawing 2 but on the base 1.

[0042] It is desirable to use for the conductive thin film 4 the particle film which consisted of particles, in order to acquire the good electron emission characteristic. Although the thickness is suitably set up in consideration of resistance, foaming conditions mentioned later between the step coverage to the component electrodes 2 and 3, the component electrode 2, and 3, it is good to consider as the range of 10 to 500A usually preferably [considering as the range of several angstroms to thousands of A], and more preferably. Rs of the resistance is the value of 102 to 107ohms / **. In addition, Rs is the resistance R which thickness measured [die length] to T and width of face measured in the die-length direction of the thin film of L by W R=Rs (L/W)

It is the appearing value when it sets. In this operation gestalt, although energization processing is mentioned as an example and explained about foaming processing, foaming processing is not restricted to this and includes the processing which the film is made to produce a crack and forms a high resistance condition.

[0043] The ingredient which constitutes the conductive thin film 4 is suitably chosen from metals, such as Pd, Pt, Ru, Ag, Au, Ti, In, Cu, Cr, Fe, Zn, Sn, Ta, W, and Pb. These metals form a conductive thin film material organometallic compound.

[0044] The particle film described here is film with which two or more particles gathered, and the condition or particle to which the particle distributed the fine structure separately has taken mutually contiguity or the condition (some particles gather, and also when island-like structure is formed as a whole, it contains.) of having overlapped. the particle size of a particle -- the range of several angstroms to thousands of A -- it is the range of 10 to 200A preferably.

[0045] The electron emission section 5 is constituted by the crack of high resistance formed in some conductive thin films 4, and becomes the thickness of the conductive thin film 4, membraneous quality, an ingredient and energization foaming mentioned later, and a thing depending on an activation process. The conductive particle of the particle size of the range of several angstroms to hundreds of A may exist in the interior of the electron emission section 5. This conductive particle contains some elements of the ingredient which constitutes the conductive thin film 4, or all elements. In the point of a crack, and the conductive thin film 4 of the near, it has carbon and a carbon compound. Carbon and a carbon compound are graphite (the so-called HOPG, and PG and GC are included.). HOPG is a nearly perfect crystal structure of graphite, and crystal grain becomes about 20A and, as for the thing and GC to which, as for PG, the crystal structure was confused a little by crystal grain by about 200A, points out that it became large [turbulence of the crystal structure] further [that. It is amorphous carbon (the mixture of amorphous carbon and amorphous carbon, and the microcrystal of said graphite is pointed out.), and as for the thickness, it is desirable to consider as the range of 500A or less and it is more desirable to consider as the range of 300A or less

[0046] Drawing 3 is the mimetic diagram showing the drop grant equipment used for the manufacture approach of this operation gestalt. drawing 3 -- setting -- a discharge head 8 -- about ten -- the thing of the ink jet method which can control in the range of dozens ng extent from ng, and the drop of the

slight amount more than dozens ng extent can form easily is desirable. The method which makes air bubbles form in a solution and makes said solution breathe out as a drop with heat energy as the ink jet method concerned is suitable.

[0047] As a drop ingredient, there are a solution, an organic metal solution, etc. which distributed the above-mentioned metal etc. and dissolved in water, a solvent, etc., for example. In drawing 3 , a discharge head 7 is installed above the substrate 1 on the substrate stage 8. The migration device (un-illustrating) is prepared in the stage 8 (or discharge head 7), and the relative position of a discharge head 7 and a stage 8 can be controlled. In addition, two or more discharge heads 7 may be formed.

[0048] For example, moving in the direction of an arrow head of drawing 3 on a stage 8 (or discharge head 7), the drop 12 of said metal content solution is made to breathe out continuously from the regurgitation nozzle 9 prepared in the discharge head 7, and it is made to adhere on a substrate.

[0049] Although the passing speed of a stage 8 (or head 7) changes with a target baton, substrate size, discharging performances, etc., it is desirable to carry out in 1mm/second - about 1000mm/second.

[0050] Moreover, the distance d between delivery-substrates of a discharge head 7 is 10 micrometers - 2mm, and the smaller one is set as 100 micrometers - 1000 micrometers from precision, such as equipment and substrate thickness, although dispersion in an impact location is suppressed.

[0051] In this operation gestalt, the head cleaning system 13 and the head surface observation device 14 possess to said drop grant equipment.

[0052] As a cleaning system 13, there are various approaches according to a class, a service condition, etc. of a discharge head 7, and an example is shown in drawing 4 . In drawing 4 , 15 is a suction pad and is connected to the vacuum pump etc. 16 is a wipe cloth, and in order that it may avoid new foreign matter adhesion for a head front face that there is no crack attachment ******, what has soft and few raising dust is desirable. A field 17 is thrown away after cleaning and is a regurgitation field.

[0053] In order to defecate a discharge head 7 by the cleaning system 13, the ink of the suitable amount extrusion and a nozzle point is refreshed for the ink in the nozzle 9 of a discharge head 7 (said metal content solution) by contacting the suction pad 15 at the tip of a discharge head 7, and attracting it first. Next, after contacting the wipe cloth 16 at the tip of a discharge head, adhesion ink and the foreign matter around the front face of a nozzle 9 are wiped off by moving. In addition, either the wipe cloth 16 or the discharge head 7 is OK as making it move.

[0054] It is the cleanliness at the tip of a nozzle after wiping being decided by the class of wipe cloth, the forcing load, a migration (wiping) rate, etc., and carrying out fixed control of these by automation, and it becomes possible to maintain the always same condition. Although each conditions are decided by the class of a discharge head and wipe cloth etc., as a forcing load, 10g-2000g, and passing speed have a desirable second in 1mm/second - 1000mm /.

[0055] Then, it throws away, and in 5 appearance field 17, the suitable amount regurgitation of the ink is carried out from a discharge head 7, and a discharge condition is stabilized.

[0056] Furthermore, according to the head surface observation device 14, adhesion of the dirt of the front face of the discharge head 7 after cleaning, a crack, and a foreign matter, the plugging condition of ink, etc. are observed, and after checking that it is satisfactory, it shifts to the regurgitation process to an actual substrate.

[0057] A gestalt which observes the image of small CCD camera 18 as shown in Fig. 1 by the monitor 19 that the surface observation device 14 should just be what can observe a head front face is raised.

[0058] In addition, as long as it may perform said head surface observation process also before said head cleaning process and it is satisfactory there, it may skip said head cleaning process and may shift to the regurgitation process to an actual substrate. moreover, the thing for which the distance of a discharge head 7 and a substrate 1 is set up comparatively narrowly with 100 micrometers - 1000 micrometers as mentioned above at an actual drop grant process — since many, when it is difficult to perform said head cleaning process and a head observation process in the condition as it is, it is missing a head or stage side in the direction of either X, Y and Z, and said head cleaning process and a head

observation process may be performed.
[0059] In order to manufacture image formation equipment based on the above, after washing the insulating substrate 1 enough and drying it by an organic solvent etc., the component electrodes 2 and 3 are first formed using a spatter – photolithography technique etc. Next, sequential formation of the direction wiring 11 of a train and the line writing direction wiring 10 which while will be rich insulator layer 6 and is connected with a component electrode is carried out.
[0060] Next, this substrate is fixed on the stage 8 of the drop grant equipment in this invention. Maintaining the surface state of a head 7 (and nozzle 9) at stability, and moving on a stage (or head side) using said head surface cleaning system 13 and the head surface observation device 14 The drop 12 of the solution containing the ingredient which forms the component film 4 is given continuously, and the conductive thin film 4 is formed by calcinating at 300–400 degrees C.
[0061] Then, as an energization foaming process, between the component electrode 2 and 3, it energizes from a non–illustrated power source and the electron emission section 5 which breaks, deforms or deteriorated the conductive thin film 4 locally is formed. This electron emission section 5 is the crack of high resistance formed in some component film 4.
[0062] Moreover, after ending energization foaming, in order to make the carbon or the carbon compound resulting from the organic substance which exists in a vacuum deposit on a conductive thin film and to change the component current If and the emission current Ie, processing called an activation process may be performed.
[0063] Thus, after forming a panel using a face plate, a housing, etc. by which the fluorescent screen was formed in the glass substrate, using the formed electron source substrate as a rear plate and exhausting this interior of a panel to a vacuum, it closes and an image display panel is constituted.
[0064] Furthermore, a drive circuit etc. can be connected to said image display panel, and image formation equipment as shown in drawing 1 can be obtained.
[0065] As explained above, according to this operation gestalt, it is low cost, and a uniform component electrode and a conductive thin film are easily formed in a large area correctly and certainly, and manufacture of the electron source substrate equipped with the electron emission component of a uniform surface conduction mold, as a result manufacture of the image formation equipment which has the electron source substrate concerned are attained.
[0066]
[Example] Hereafter, the concrete example of this invention is explained.
[0067] (Example 1) The electron source substrate which has many surface conduction mold electron emission components was produced using the substrate formed by approach which mentioned wiring and a component electrode above in the shape of a matrix. Hereafter, the production process of a surface conduction mold electron emission component is explained, making drawing 2 – drawing 4 reference.
[0068] 1. It was made to fully dry at 120 degrees C after washing with an organic solvent etc., using the blue plate glass substrate of 900x600 (mm) as an insulating substrate 1. On this substrate 1, the component electrodes 2 and 3 which use a vacuum membrane formation technique and a photolithography technique, and consist of Pt were formed. Distance of 200A and the component electrodes 2 and 3 was set to 20 micrometers for the thickness of Pt at this time.
[0069] 2. Next, the direction wiring 11 of a train which consists of nickel using a vacuum membrane formation technique and a photolithography technique was formed. Wiring width of face at this time was made to 300 micrometers, and thickness was made into 500A. Furthermore, the insulator layer 6 was formed on the direction wiring 11 of a train using the vacuum membrane formation technique, the photolithography technique, and the etching technique. Thickness of an insulator layer 6 was made into 5000A. Then, the line writing direction wiring 10 which consists of Au using a vacuum membrane formation technique and a photolithography technique was formed. Width of face of wiring was made to 200 micrometers, and thickness was made into 5000A.
[0070] 3. After adsorbing said substrate on the stage 8 of the drop grant equipment in this invention and

performing alignment of a pattern etc. after that, when head 7 front face was observed by the surface observation device 14, the lack of liquid of the point by desiccation was checked. Then, the head cleaning system 13 cleaned. After vacuum suction cleaned operation conditions for 0.2 seconds with the contact load of 200g, and the passing speed of 40mm/second, using a rubicelle (trade name) as a wipe cloth, they were thrown away, were thrown away for 0.5 seconds in the regurgitation field 17, performed the regurgitation, and observed the head front face again using said surface observation device 14. The lack of liquid of a point is canceled and it checked that there were no abnormalities, such as generating of a surface blemish and adhesion of a foreign matter. Then, the drop 12 of the solution containing the ingredient which forms the component film 4 was given. As a solution, the organic palladium content solution (acetic–acid Pd–monoethanolamine complex 0.4wt% and isopropyl alcohol 20% and ethylene glycol 1.0% and polyvinyl alcohol 0.05% water solution) was used. A scanning speed of the stage at this time was 300mm/second, and the regurgitation rate of a drop was about 10m/second. Heat–treatment for 10 minutes was performed at 300 more degrees C, and the conductive thin film 4 which consists of an oxidization palladium (PdO) particle of 100A of thickness was formed.

[0071] 4. further — an electrode pair — the electrical potential difference was impressed between 2 and 3, and the electron emission section 5 was formed by carrying out energization processing (energization foaming) of the conductive thin film 4.

[0072] In this way, to the produced electron source substrate, the display panel was produced combining the face plate, the housing, etc., the drive circuit was connected further, and image formation equipment was produced.

[0073] Since the electron emission component produced like the above by the manufacture approach of this example has the stable regurgitation of the drop which forms the component film, the configuration of the component electrode 2 in front of foaming and the component film between three and its dispersion of resistance are small. For this reason, the current flowed on the component film at homogeneity, and the crack was formed uniformly, and the current flowed also for the electron emission component at homogeneity, and there was little dispersion in a component property and it was able to obtain good image formation equipment with the sufficient yield.

[0074] (Example 2) In this example, two or more nozzles were used for coincidence using the discharge head of class with an another example 1. In this discharge head, 64 regurgitation nozzles were prepared in one head, and the electron source substrate was produced by the same approach as an example 1, using four of nozzles of this for coincidence. Cleaning conditions presupposed that it is the same as an example 1. In this example, the manufacture baton has been shortened to 4 by about 1/, without breaking down the stability of the regurgitation. Furthermore, when the electron emission component was manufactured by the same approach as an example 1, good image formation equipment was able to be obtained with the sufficient yield.

[0075] (Example 3) In this example, the electron source substrate was produced by the same approach as an example 2, using four nozzles each of two heads of the class used in the example 2 for coincidence using the same approach as an example 2. Cleaning conditions presupposed that it is the same as an example 1. Furthermore, when 50 electron source substrates were continuously manufactured on this condition, the regurgitation stabilized over all substrates was obtained. In addition, the count sum total of cleaning of the head at the time of 50–sheet manufacture was about 100 times including regurgitation alignment etc.

[0076] Furthermore, when an electron emission component and image formation equipment were manufactured by the same approach as an example 1 using these electron source substrates, good image formation equipment was able to be obtained with the sufficient yield in a short time.

[0077] (Example 4) Drawing 5 is the mimetic diagram showing the electron source substrate produced in an example 4. Here, the component electrodes 2 and 3 other than the conductive thin film 4 were produced by the manufacture approach in this operation gestalt.

[0078] 1. This was fully dried at 120 degrees C after washing with the organic solvent etc., using the

'blue plate glass substrate of 900x600 (mm) as an insulating substrate 1. The direction wiring 11 of a train which uses a vacuum membrane formation technique and screen printing, and consists of nickel was formed on this substrate 1. At this time, width of face of wiring was made to 300 micrometers, and that thickness was made into 500A. After forming the insulator layer 6 with a thickness of 5000A on the line writing direction wiring 11 still more nearly similarly, the line writing direction wiring 10 which consists of Au similarly was formed. The width of face of wiring made 200 micrometers and thickness 5000A.

[0079] 2. The insulating substrate 1 was adsorbed on the stage 8 of the drop grant equipment in this invention, and the drop 12 of the solution containing the ingredient which forms the component film 4 was given, using the surface observation device 14 and the head cleaning system 13 like an example 1. As a solution, the organic palladium content solution (acetic-acid Pd-monoethanolamine complex 0.4wt% and isopropyl alcohol 20% and ethylene glycol 1.0% and polyvinyl alcohol 0.05% water solution) was used. The regurgitation rate of 500mm /and a drop of a scanning speed of the stage at this time was about 10m/second a second.

[0080] 3. Furthermore, heat-treatment for 5 minutes was performed at 100 degrees C to the insulating substrate 1.

[0081] 4. Next, it is an organic platinum content solution (acetic-acid platinum-monoethanolamine complex 0.4wt% and isopropyl alcohol 20%, 80% of water) (it used, and the component electrode 3 was formed after forming so that the component electrode 2 may be connected to the direction wiring 11 of a train, then so that it might connect with the line writing direction wiring 10 in the location shifted 120 micrometers from this component electrode 2.) on an insulating substrate 1 similarly.

[0082] 5. Furthermore, heat-treatment for 10 minutes was performed at 300 degrees C to the insulating substrate 1, and the conductive thin film 4 which consists of an oxidization palladium (PdO) particle of 100A of thickness, and the component electrodes 2 and 3 which consist of Pt were formed. As for the component electrodes 2 and 3, 310 micrometers and the thickness of those controlled the width of face of 20 micrometers and an electrode for gap spacing to 300A.

[0083] 6. Furthermore, the electrical potential difference was impressed among the component electrodes 2 and 3, and the electron emission section 5 was formed by carrying out energization processing (energization foaming) of the conductive thin film 4.

[0084] In this way, to the produced electron source substrate, the display panel was produced combining the face plate, the housing, etc., the drive circuit was connected further, and image formation equipment was produced. Consequently, the same good image formation equipment as an example 1 was able to be obtained.

[0085]

[Effect of the Invention] According to this invention, it becomes possible to prevent generating of the poor regurgitation and poor formation of the component electrode by impact location gap, and the component film, it can manufacture a uniform component electrode and the component film with the sufficient yield, and becomes possible [the yield being good and manufacturing the electron source substrate which has a good component property to the whole large area substrate surface by low cost].

[Translation done.]

2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the outline perspective view showing the main configurations of the image formation equipment manufactured according to this operation gestalt.
[Drawing 2] It is the mimetic diagram showing the configuration of a surface conduction mold electron emission component.
[Drawing 3] It is the mimetic diagram showing the drop grant equipment used for the manufacture approach of this operation gestalt.
[Drawing 4] It is the mimetic diagram showing an example of the cleaning system of drop grant equipment.
[Drawing 5] It is the mimetic diagram showing the electron source substrate produced in one example.
[Drawing 6] It is the mimetic diagram showing the conventional surface conduction mold electron emission component.
[Drawing 7] It is the mimetic diagram showing the drop grant equipment which breathes out the conventional metal content solution on a substrate, and forms the component electrode and the conductive thin film of a pair.
[Description of Notations]
1 Substrate
2 Three Component electrode
4 Conductive Thin Film
5 Electron Emission Section
6 Insulator Layer
7 Discharge Head
8 Substrate Stage
9 Regurgitation Nozzle
10 The Direction Wiring of Train
11 Line Writing Direction Wiring
12 Drop
13 Head Cleaning System
14 Head Surface Observation Device
15 Suction Pad
16 Wipe Cloth
17 Throw Away and it is Regurgitation Field.
18 Small CCD Camera
19 Monitor for Observation

[Translation done.]

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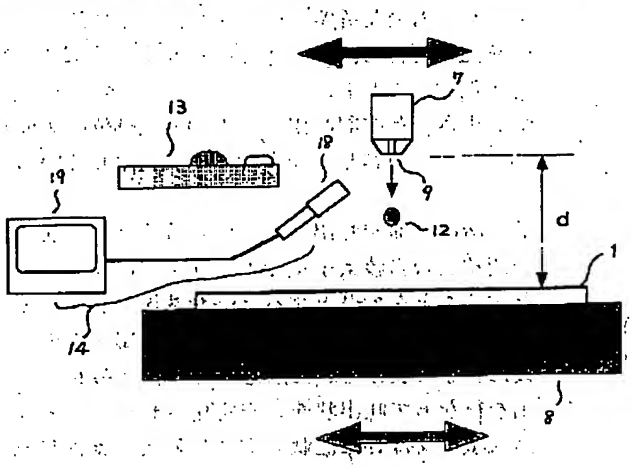
(54)【発明の名称】　電子源基板の製造方法、画像形成装置の製造方法、電子源基板の製造装置及び画像形成装置の製造装置

(57)【要約】
【課題】　低コストで且つ容易に大面積に均一な素子電極及び導電性薄膜を正確且つ確実に形成し、均一な表面伝導型の電子放出素子を実現する。
【解決手段】　ヘッド清掃機構１３及びヘッド表面観察機構１４が具備されており、先ず、吸引パッド１５を吐出ヘッド７の先端に接触させ吸引することで、吐出ヘッド７のノズル９内のインク（前記金属含有溶液）を適当量吸い出し、ノズル先端部のインクをリフレッシュする。次に、ワイプ布１６を吐出ヘッド先端に接触させた後、移動することで、ノズル９の表面及び周辺の付着インクや異物を拭き取る。しかる後、清掃後の吐出ヘッド７の表面の汚れ、キズ、異物の付着、インクの詰まり具合等を観察し、問題が無いことを確認する。



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【特許請求の範囲】

【請求項１】　絶縁基板上に、一対の素子電極と、前記各素子電極間を連結する導電性薄膜とを有し、前記導電性薄膜の一部に電子放出部が形成されてなる電子放出素子が複数配列されてなる電子源基板の製造方法であって、

少なくとも前記導電性薄膜を形成するに際して、

金属元素を含む溶液を吐出する吐出ヘッドの先端部位を清浄化した後に、

前記溶液を前記吐出ヘッドから液滴として前記各素子電極間を含む当該素子電極上に吐出し付与することを特徴とすることを特徴とする電子源基板の製造方法。

【請求項２】　絶縁基板上に、一対の素子電極と、前記各素子電極間を連結する導電性薄膜とを有し、前記導電性薄膜の一部に電子放出部が形成されてなる電子放出素子が複数配列されてなる電子源基板の製造方法であって、

少なくとも前記導電性薄膜を形成するに際して、

金属元素を含む溶液を吐出する吐出ヘッドの先端部位の表面状態をモニターして観察し、吐出状態が安定化していることを確認した後に、

前記溶液を前記吐出ヘッドから液滴として前記各素子電極間を含む当該素子電極上に吐出し付与することを特徴とすることを特徴とする電子源基板の製造方法。

【請求項３】　絶縁基板上に、一対の素子電極と、前記各素子電極間を連結する導電性薄膜とを有し、前記導電性薄膜の一部に電子放出部が形成されてなる電子放出素子が複数配列されてなる電子源基板の製造方法であって、

少なくとも前記導電性薄膜を形成するに際して、

金属元素を含む溶液を吐出する吐出ヘッドの先端部位を清浄化するとともに、

清浄化された前記吐出ヘッドの先端部位の表面状態をモニターして観察し、吐出状態が安定化していることを確認し、

前記溶液を前記吐出ヘッドから液滴として前記各素子電極間を含む当該素子電極上に吐出し付与することを特徴とすることを特徴とする電子源基板の製造方法。

【請求項４】　前記吐出ヘッドの先端部位を清浄化した後に、予め設けられた所定領域に前記溶液の適当量の吐出を行なって吐出状態を安定化させることを特徴とする請求項１又は３に記載の電子源基板の製造方法。

【請求項５】　前記吐出ヘッドを用いた前記溶液の吐出がインクジェット方式によるものであることを特徴とする請求項１～４のいずれか１項に記載の電子源基板の製造方法。

【請求項６】　複数の吐出ノズルが設けられた前記吐出ヘッドを用いて、前記溶液の吐出を行なうことを特徴とする請求項５に記載の電子源基板の製造方法。

【請求項７】　前記インクジェット方式が、熱エネルギ

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ーによって前記溶液内に気泡を形成させて前記溶液を液滴として吐出させる方式であることを特徴とする請求項５又は６に記載の電子源基板の製造方法。

【請求項８】　列方向配線及び行方向配線を絶縁層を介して行列状に配置する際に、前記各素子電極の一方を前記絶縁基板上に接続して列方向配線とし、他方を絶縁層を介して接続して行方向配線とすることを特徴とする請求項１～７のいずれか１項に記載の電子源基板の製造方法。

【請求項９】　電子源としての電子放出素子と、前記電子放出素子への電圧印加手段と、前記電子放出素子から放出される電子を受けて発光する発光体と、外部信号に基づいて前記電子放出素子へ印加する電圧を制御する駆動回路とを具備する画像形成装置の製造方法であって、

前記電子放出素子を請求項１～７のいずれかに記載の電子源基板の製造方法により製造することを特徴とする画像形成装置の製造方法。

【請求項１０】　絶縁基板上に、一対の素子電極と、前記各素子電極間を連結する導電性薄膜とを有し、前記導電性薄膜の一部に電子放出部が形成されてなる電子放出素子が複数配列されてなる電子源基板の製造装置であって、

少なくとも、金属元素を含む溶液を液滴として吐出ヘッドから吐出する手段と、

前記吐出ヘッドと前記絶縁基板との相対位置を制御する手段と、

前記吐出ヘッドの先端部位を清浄化する手段とを備えることを特徴とする電子源基板の製造装置。

【請求項１１】　絶縁基板上に、一対の素子電極と、前記各素子電極間を連結する導電性薄膜とを有し、前記導電性薄膜の一部に電子放出部が形成されてなる電子放出素子が複数配列されてなる電子源基板の製造装置であって、

少なくとも、金属元素を含む溶液を液滴として吐出ヘッドから吐出する手段と、

前記吐出ヘッドと前記絶縁基板との相対位置を制御する手段と、

前記吐出ヘッドの先端部位の表面状態をモニターして観察し、吐出状態が安定化していることを確認する手段とを備えることを特徴とする電子源基板の製造装置。

【請求項１２】　絶縁基板上に、一対の素子電極と、前記各素子電極間を連結する導電性薄膜とを有し、前記導電性薄膜の一部に電子放出部が形成されてなる電子放出素子が複数配列されてなる電子源基板の製造装置であって、

少なくとも、金属元素を含む溶液を液滴として吐出ヘッドから吐出する手段と、

前記吐出ヘッドと前記絶縁基板との相対位置を制御する手段と、

前記吐出ヘッドの先端部位を清浄化する手段と、

前記吐出ヘッドの先端部位の表面状態をモニターして観察し、吐出状態が安定化していることを確認する手段とを備えることを特徴とする電子源基板の製造装置。

【請求項１３】　前記吐出ヘッドの先端部位を清浄化する手段は、前記清浄化の後に、予め設けられた所定領域に前記溶液の適当量の吐出を行なって吐出状態を安定化させる機構を有することを特徴とする請求項１０～１２のいずれか１項に記載の電子源基板の製造装置。

【請求項１４】　前記吐出ヘッドが、インクジェット方式によるものであることを特徴とする請求項１０～１３のいずれか１項に記載の電子源基板の製造装置。

【請求項１５】　前記吐出ヘッドに、複数の吐出ノズルが設けられていることを特徴とする請求項１４に記載の電子源基板の製造装置。

【請求項１６】　複数の吐出ヘッドが設けられていることを特徴とする請求項１４又は１５に記載の電子源基板の製造装置。

【請求項１７】　前記インクジェット方式が、熱エネルギーによって前記溶液内に気泡を形成させて前記溶液を液滴として吐出させる方式であることを特徴とする請求項１４～１６のいずれか１項に記載の電子源基板の製造装置。

【請求項１８】　電子源としての電子放出素子と、前記電子放出素子への電圧印加手段と、前記電子放出素子から放出される電子を受けて発光する発光体と、外部信号に基づいて前記電子放出素子へ印加する電圧を制御する駆動回路とを具備する画像形成装置の製造装置であって、

請求項１０～１７のいずれかに記載の電子源基板の製造装置を備えることを特徴とする画像形成装置の製造装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、電子源基板の製造方法、画像形成装置の製造方法、電子源基板の製造装置、及び画像形成装置の製造装置に関し、特に、電子源として表面伝導型の電子放出素子が形成されてなるものを対象とする。

【０００２】

【従来の技術】従来より、電子放出素子としては大別して熱電子放出素子と冷陰極電子放出素子を用いた２種類のものが知られている。冷陰極電子放出素子には電界放出型（以下「ＦＥ型」という）、金属／絶縁層／金属型（以下、「ＭＩＭ型」と称する。）や表面伝導型電子放出素子等がある。

【０００３】ＦＥ型の例としては、W. P. Dyke & W. W. Dolan, "Field emission", Advance in Electron Physics, 8, 89 (1956)あるいはC. A. Spindt, "PHYSICAL Properties of thin-film field emission cathodes with molybdenium cones", J. Appl. Phys., 47, 5248 (1976)等に開示されたものが知られている。

【０００４】他方、ＭＩＭ型の例としては、C. A. Mead, "Operation of Tunnel-EmissionDevices", J. Appl. Phys., 32, 646 (1961)等に開示されたものが知られている。

【０００５】表面伝導型電子放出素子型の例としては、M. I. Elinson, Radio Eng. Electron Pys., 10, 1290 (1965)等に開示されたものがある。表面伝導型電子放出素子は、基板上に形成された小面積の薄膜に、膜面に平行に電流を流すことにより、電子放出が生ずる現象を利用するものである。この表面伝導型電子放出素子としては、前記Elinson等によるSnO_2薄膜を用いたもの、Au薄膜によるもの〔G. Dittmer, "Thin Solid Films", 9, 317 (1972)〕、In_2O_3／SnO_2薄膜によるもの〔M. Hartwell and C. G. Fonstad, "IEEE Trans. ED Conf. ", 519 (1975)〕、カーボン薄膜によるもの〔荒木久他，真空，第26巻，第1号，22頁（1983）〕等が報告されている。

【０００６】これらの表面伝導型電子放出素子の典型的な例として前述のM. Hartwellの素子構成を図６（（ａ）：平面図、（ｂ）：断面図）に模式的に示す。同図において、１はガラス基体、２，３はガラス基体１上で互いに対向するように形成されてなる一対の素子電極である。４は導電性薄膜で、Ｈ型形状のパターンに、金属酸化物を材料としてスパッタ法等で形成されるものであり、この導電性薄膜４に通電フォーミングと呼ばれる通電処理が施されて電子放出部５が形成される。

【０００７】本発明者らは、表面伝導型電子放出素子の安価かつ平易な作製手法を特開平８－１７１８５０号公報で開示した。この手法は、金属含有溶液を液滴状態で基板上に吐出して、素子電極２，３及び導電性薄膜４を形成することにより、表面伝導型電子放出素子を作製する方法である。

【０００８】図７は、本発明者らによる従来の、金属含有溶液を基板上に吐出して一対の素子電極及び導電性薄膜を形成する液滴付与装置を示す模式図である。図７において、基板ステージ８上の基体１の上方に吐出ヘッド７が設置されており、矢印方向に基板ステージ８を位置調整した後に吐出ヘッド７に設けられた吐出ノズル９から金属含有溶液を液滴１２の状態で吐出し、基体１上に着弾させて付着させる。その後、焼成等により素子電極及び導電性薄膜を形成する。

【０００９】なお、図７では、基板の上方に吐出ヘッドを配置した場合を例示するが、逆に吐出ヘッドを下方に配置して下から吐出したり、或いは横方向に配置して吐出するようにしても良い。

【００１０】

【発明が解決しようとする課題】上述した液滴付与により、素子電極及び導電性薄膜を容易に形成することができ、製造工程の短縮化を図り、多数の表面伝導型電子放

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出素子を短時間で大面積に形成することが可能となる。

【００１１】しかしながら、表面伝導型電子放出素子の形成不良を抑止して更なる正確且つ確実な形成を期するには、前記従来の液滴付与工程に工夫を加えることが必要である。

【００１２】具体的には、以下の点について改善が待たれる。

①ノズル先端の乾燥や溶液の蒸発による液不足

②異物混入や溶液の固化によるノズルの詰まり

③異物付着やノズル表面の傷による液溜りの発生

【００１３】本発明の目的は、低コストで且つ容易に大面積に均一な素子電極及び導電性薄膜を正確且つ確実に形成し、均一な表面伝導型の電子放出素子を備えた電子源基板の製造方法、この電子源基板を備えた画像形成装置の製造方法、電子源基板の製造装置及び画像形成装置の製造装置を提供することである。

【００１４】

【課題を解決するための手段】本発明の電子源基板の製造方法は、絶縁基板上に、一対の素子電極と、前記各素子電極間を連結する導電性薄膜とを有し、前記導電性薄膜の一部に電子放出部が形成されてなる電子放出素子が複数配列されてなる手法であって、少なくとも前記導電性薄膜を形成するに際して、金属元素を含む溶液を吐出する吐出ヘッドの先端部位を清浄化した後に、前記溶液を前記吐出ヘッドから液滴として前記各素子電極間を含む当該素子電極上に吐出し付与する。

【００１５】本発明の電子源基板の製造方法は、絶縁基板上に、一対の素子電極と、前記各素子電極間を連結する導電性薄膜とを有し、前記導電性薄膜の一部に電子放出部が形成されてなる電子放出素子が複数配列されてなる手法であって、少なくとも前記導電性薄膜を形成するに際して、金属元素を含む溶液を吐出する吐出ヘッドの先端部位の表面状態をモニターして観察し、吐出状態が安定化していることを確認した後に、前記溶液を前記吐出ヘッドから液滴として前記各素子電極間を含む当該素子電極上に吐出し付与する。

【００１６】本発明の電子源基板の製造方法は、絶縁基板上に、一対の素子電極と、前記各素子電極間を連結する導電性薄膜とを有し、前記導電性薄膜の一部に電子放出部が形成されてなる電子放出素子が複数配列されてなる手法であって、少なくとも前記導電性薄膜を形成するに際して、金属元素を含む溶液を吐出する吐出ヘッドの先端部位を清浄化するとともに、清浄化された前記吐出ヘッドの先端部位の表面状態をモニターして観察し、吐出状態が安定化していることを確認し、前記溶液を前記吐出ヘッドから液滴として前記各素子電極間を含む当該素子電極上に吐出し付与する。

【００１７】本発明の電子源基板の製造方法の一態様は、前記吐出ヘッドの先端部位を清浄化した後に、予め設けられた所定領域に前記溶液の適当量の吐出を行なって吐出状態を安定化させる。

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【００１８】本発明の電子源基板の製造方法の一態様において、前記吐出ヘッドを用いた前記溶液の吐出がインクジェット方式によるものである。

【００１９】本発明の電子源基板の製造方法の一態様は、複数の吐出ノズルが設けられた前記吐出ヘッドを用いて、前記溶液の吐出を行なう。

【００２０】本発明の電子源基板の製造方法の一態様において、前記インクジェット方式が、熱エネルギーによって前記溶液内に気泡を形成させて前記溶液を液滴として吐出させる方式である。

【００２１】本発明の電子源基板の製造方法の一態様は、列方向配線及び行方向配線を絶縁層を介して行列状に配置する際に、前記各素子電極の一方を前記絶縁基板上に接続して列方向配線とし、他方を絶縁層を介して接続して行方向配線とする。

【００２２】本発明の画像形成装置の製造方法は、電子源としての電子放出素子と、前記電子放出素子への電圧印加手段と、前記電子放出素子から放出される電子を受けて発光する発光体と、外部信号に基づいて前記電子放出素子へ印加する電圧を制御する駆動回路とを具備する手法であって、前記電子放出素子を前記電子源基板の製造方法により製造する。

【００２３】本発明の電子源基板の製造装置は、絶縁基板上に、一対の素子電極と、前記各素子電極間を連結する導電性薄膜とを有し、前記導電性薄膜の一部に電子放出部が形成されてなる電子放出素子が複数配列されてなる装置であって、少なくとも、金属元素を含む溶液を液滴として吐出ヘッドから吐出する手段と、前記吐出ヘッドと前記絶縁基板との相対位置を制御する手段と、前記吐出ヘッドの先端部位を清浄化する手段とを備える。

【００２４】本発明の電子源基板の製造装置は、絶縁基板上に、一対の素子電極と、前記各素子電極間を連結する導電性薄膜とを有し、前記導電性薄膜の一部に電子放出部が形成されてなる電子放出素子が複数配列されてなる装置であって、少なくとも、金属元素を含む溶液を液滴として吐出ヘッドから吐出する手段と、前記吐出ヘッドと前記絶縁基板との相対位置を制御する手段と、前記吐出ヘッドの先端部位の表面状態をモニターして観察し、吐出状態が安定化していることを確認する手段とを備える。

【００２５】本発明の電子源基板の製造装置は、絶縁基板上に、一対の素子電極と、前記各素子電極間を連結する導電性薄膜とを有し、前記導電性薄膜の一部に電子放出部が形成されてなる電子放出素子が複数配列されてなる装置であって、少なくとも、金属元素を含む溶液を液滴として吐出ヘッドから吐出する手段と、前記吐出ヘッドと前記絶縁基板との相対位置を制御する手段と、前記吐出ヘッドの先端部位を清浄化する手段と、前記吐出ヘッドの先端部位の表面状態をモニターして観察し、吐出

状態が安定化していることを確認する手段とを備える。

【００２６】本発明の電子源基板の製造装置の一態様において、前記吐出ヘッドの先端部位を清浄化する手段は、前記清浄化の後に、予め設けられた所定領域に前記溶液の適当量の吐出を行なって吐出状態を安定化させる機構を有する。

【００２７】本発明の電子源基板の製造装置の一態様において、前記吐出ヘッドが、インクジェット方式によるものである。

【００２８】本発明の電子源基板の製造装置の一態様において、前記吐出ヘッドに、複数の吐出ノズルが設けられている。

【００２９】本発明の電子源基板の製造装置の一態様において、複数の吐出ヘッドが設けられている。

【００３０】本発明の電子源基板の製造装置の一態様において、前記インクジェット方式が、熱エネルギーによって前記溶液内に気泡を形成させて前記溶液を液滴として吐出させる方式である。

【００３１】本発明の画像形成装置の製造装置は、電子源としての電子放出素子と、前記電子放出素子への電圧印加手段と、前記電子放出素子から放出される電子を受けて発光する発光体と、外部信号に基づいて前記電子放出素子へ印加する電圧を制御する駆動回路とを具備する装置であって、前記電子源基板の製造装置を備える。

【００３２】

【作用】本発明の電子源基板の製造方法においては、表面伝導型電子放出素子の素子電極及び導電性薄膜を形成するに際して、金属元素を含む溶液を吐出する吐出ヘッドの先端部位を清浄化し、或いは吐出ヘッドの先端部位の表面状態をモニターし観察して吐出状態が安定化していることを確認し、又は清浄化及びモニターによる観察・確認の双方を行なう。この場合、前記清浄化により吐出ノズル先端の乾燥や液溜りの除去が可能となり、清掃前後のヘッド（及びノズル）表面を観察、評価することで、吐出不良や着弾位置ずれによる素子電極及び導電性薄膜の形成不良の発生を防ぐことが可能となり、大面積に対して均一な素子電極及び導電性薄膜を歩留まり良く製造することができる。しかも、清浄化及びモニターによる観察・確認の双方を行なうことで、より正確且つ確実に素子電極及び導電性薄膜の所期の形成が可能となる。

【００３３】

【発明の実施の形態】図１は、本実施形態により製造される画像形成装置の主要構成を示す概略斜視図である。図１において、画像形成装置はアノード基板１０及びカソード基板１を備えて構成されており、カソード基板１は、電子源として用いられる表面伝導型の電子放出素子１５（図中、円内に示す。）がマトリクス状（行列状）に多数配されて構成されている。アノード基板１０は、カラー表示を行うためのR，G，B用の蛍光体面１８、

この蛍光体面１８を覆うアルミニウムを材料とした厚み１００（ｎｍ）程度のメタルバック面１９がガラス基体１７に埋設固定されて構成されている。

【００３４】更に、１２はｘ方向配線、１３はｙ方向配線であり、１６はカソード基板１を支えるリアプレート、２０はアノード基板１０とカソード基板１を固定する支持枠である。

【００３５】図２は、表面伝導型の電子放出素子１５の構成を示す模式図であり、同図中（ａ）は平面図、（ｂ）は（ａ）中の一点鎖線Ａ－Ａ’に沿った断面図である。

【００３６】電子放出素子１５は、基体１（カソード基板１）上で隣接する一対の素子電極２，３と、これら素子電極２，３に接続されて一部位に電子放出部５を有する導電性薄膜４とを有してなる素子である。電子放出部５は、導電性薄膜４の一部が、破壊、変形ないし変質され、高抵抗状態とされた部分である。また、電子放出部５及びその周辺には、電子放出を制御するため、炭素あるいは炭素化合物を主成分とする堆積膜が形成されている場合がある。

【００３７】この電子放出素子１５は、行方向電極１２及び列方向電極１３を介して素子電極２，３間に１５（Ｖ）程度の電圧を印加することにより当該素子電極２，３間に素子電流Ｉｆを供給し、電子放出部５から電子を放出させることができる。

【００３８】基体１としては、石英ガラス、Ｎａ等の不純物含有量を減少したガラス、青板ガラス、青板ガラスにスパッタ法等により形成したSiO_2を積層したガラス基体及びアルミナ等のセラミックス及びＳｉ基体等を用いることができる。

【００３９】対向する素子電極２，３の材料としては、一般的な導体材料を用いることができる。これは例えばＮｉ，Ｃｒ，Ａｕ，Ｍｏ，Ｗ，Ｐｔ，Ｔｉ，Ａｌ，Ｃｕ，Ｐｄ等の金属又は合金、及びＰｄ，Ａｇ，Ａｕ，RuO_2，Ｐｄ－Ａｇ等の金属又は金属酸化物とガラス等から構成される印刷導体、In_2O_3－SnO_2等の透明導電体及びポリシリコン等の半導体導体材料等から適宜選択することができる。

【００４０】素子電極間隔Ｌ、素子電極長さＷ、導電性薄膜４の形状等は、応用される形態等を考慮して設計される。素子電極間隔Ｌは、好ましくは数千Åから数百μｍの範囲とすることができ、より好ましくは素子電極間に印加する電圧等を考慮して数μｍから数十μｍの範囲とすることができる。素子電極長さＷは、電極の抵抗値、電子放出特性を考慮して、数μｍから数百μｍの範囲とすることができる。また、素子電極２，３の膜厚ｄは、数百Åから数μｍの範囲とすることができる。

【００４１】なお、図２に示した構成だけでなく、基体１上に、導電性薄膜４、対向する素子電極２，３の順に積層した構成とすることもできる。

【００４２】導電性薄膜４には、良好な電子放出特性を得るために、微粒子で構成された微粒子膜を用いるのが好ましい。その膜厚は、素子電極２，３へのステップカバレージ、素子電極２，３間の抵抗値及び後述するフォーミング条件等を考慮して適宜設定されるが、通常は、数Åから数千Åの範囲とするのが好ましく、より好ましくは１０Åから５００Åの範囲とするのが良い。その抵抗値は、Ｒｓが１０２から１０７Ω／□の値である。なおＲｓは、厚さがＴ、幅がＷで長さがＬの薄膜の長さ方向に測定した抵抗Ｒを、

Ｒ＝Ｒｓ（Ｌ／Ｗ）

とおいたときに現れる値である。本実施形態において、フォーミング処理については、通電処理を例に挙げて説明するが、フォーミング処理はこれに限られるものではなく、膜に亀裂を生じさせて高抵抗状態を形成する処理を包含するものである。

【００４３】導電性薄膜４を構成する材料は、Ｐｄ，Ｐｔ，Ｒｕ，Ａｇ，Ａｕ，Ｔｉ，Ｉｎ，Ｃｕ，Ｃｒ，Ｆｅ，Ｚｎ，Ｓｎ，Ｔａ，Ｗ，Ｐｂ等の金属の中から適宜選択される。これらの金属は、導電性薄膜材料有機金属化合物を形成する。

【００４４】ここで述べる微粒子膜とは、複数の微粒子が集合した膜であり、その微細構造は、微粒子が個々に分散配置した状態あるいは微粒子が互いに隣接、あるいは重なり合った状態（いくつかの微粒子が集合し、全体として島状構造を形成している場合も含む。）をとっている。微粒子の粒径は、数Åから数千Åの範囲、好ましくは、１０Åから２００Åの範囲である。

【００４５】電子放出部５は、導電性薄膜４の一部に形成された高抵抗の亀裂により構成され、導電性薄膜４の膜厚、膜質、材料及び後述する通電フォーミング、活性化工程に依存したものとなる。電子放出部５の内部には、数Åから数百Åの範囲の粒径の導電性微粒子が存在する場合もある。この導電性微粒子は、導電性薄膜４を構成する材料の元素の一部、あるいは全ての元素を含有するものとなる。亀裂の先端部及びその近傍の導電性薄膜４には、炭素及び炭素化合物を有する。炭素及び炭素化合物とは、例えばグラファイト（いわゆるＨＯＰＧ、ＰＧ、ＧＣを包含する。ＨＯＰＧはほぼ完全なグラファイトの結晶構造であり、ＰＧは結晶粒が２００Å程度で結晶構造がやや乱れたもの、ＧＣは結晶粒が２０Å程度になり結晶構造の乱れが更に大きくなったものを指す。）、非晶質カーボン（アモルファスカーボン、及びアモルファスカーボンと前記グラファイトの微結晶の混合物を指す。）であり、その膜厚は、５００Å以下の範囲とするのが好ましく、３００Å以下の範囲とすることがより好ましい。

【００４６】図３は、本実施形態の製造方法に用いる液滴付与装置を示す模式図である。図３において、吐出ヘッド８は、十数ｎｇから数十ｎｇ程度の範囲で制御が可能で、且つ数十ｎｇ程度以上の微少量の液滴が容易に形成できるインクジェット方式のものが好ましい。当該インクジェット方式としては、熱エネルギーによって溶液内に気泡を形成させて前記溶液を液滴として吐出させる方式が好適である。

【００４７】液滴材料としては、例えば、水、溶剤等に前述の金属等を分散、溶解した溶液、有機金属溶液等がある。図３において、基板ステージ８上の基板１の上方に吐出ヘッド７が設置される。ステージ８（或いは吐出ヘッド７）には、移動機構（不図示）が設けられており、吐出ヘッド７とステージ８の相対位置を制御することができる。なお、吐出ヘッド７を複数設ける場合もある。

【００４８】例えば、図３の矢印方向に、ステージ８（或いは吐出ヘッド７）を移動しながら、吐出ヘッド７に設けられた吐出ノズル９から前記金属含有溶液の液滴１２を連続的に吐出させ、基板上に付着させる。

【００４９】ステージ８（或いはヘッド７）の移動速度は、目標タクトと基板サイズ、及び吐出性能等によって異なるが、１ｍｍ／秒～１０００ｍｍ／秒程度とすることが好ましい。

【００５０】また、吐出ヘッド７の吐出口－基板間距離ｄは、１０μｍ～２ｍｍであり、小さい方が着弾位置のばらつきが抑えられるが、装置及び基板厚み等の精度から１００μｍ～１０００μｍに設定される。

【００５１】本実施形態においては、前記液滴付与装置に、ヘッド清掃機構１３及びヘッド表面観察機構１４が具備されている。

【００５２】清掃機構１３としては、吐出ヘッド７の種類や使用条件等により様々な方法があり、一例を図４に示す。図４において、１５は吸引パッドであり、真空ポンプ等に接続されている。１６はワイプ布であり、ヘッド表面をキズ付けること無く、また、新たな異物付着を避けるため、やわらかくて発塵の少ないものが好ましい。領域１７は清掃後の捨て吐出領域である。

【００５３】清掃機構１３により吐出ヘッド７の清浄化を行なうには、先ず、吸引パッド１５を吐出ヘッド７の先端に接触させ吸引することで、吐出ヘッド７のノズル９内のインク（前記金属含有溶液）を適当量吸い出し、ノズル先端部のインクをリフレッシュする。次に、ワイプ布１６を吐出ヘッド先端に接触させた後、移動することで、ノズル９の表面及び周辺の付着インクや異物を拭き取る。なお、移動させるのは、ワイプ布１６或いは吐出ヘッド７のどちらでもかまわない。

【００５４】拭き取り後のノズル先端の清浄度は、ワイプ布の種類、押し付け荷重、移動（拭き取り）速度等によって決まり、これらを自動化により一定制御することで、常に同じ状態を保つことが可能になる。各々の条件は、吐出ヘッド及びワイプ布の種類等によって決まるが、押し付け荷重としては、１０ｇ～２０００ｇ、移動

速度は、１mm／秒～１０００mm／秒が好ましい。

【００５５】その後、捨て５出領域１７において、吐出ヘッド７からインクを適当量吐出させ、吐出状態を安定させる。

【００５６】更に、ヘッド表面観察機構１４により、清掃後の吐出ヘッド７の表面の汚れ、キズ、異物の付着、インクの詰まり具合等を観察し、問題が無いことを確認した上で実際の基板への吐出プロセスに移行する。

【００５７】表面観察機構１４は、ヘッド表面が観察できるものであれば良く、例えば第１図に示すような、小型ＣＣＤカメラ１８の映像をモニター１９で観察するような形態があげられる。

【００５８】なお、前記ヘッド表面観察工程は、前記ヘッド清掃工程の前にも行なっても良く、そこで問題が無ければ、前記ヘッド清掃工程を省略して実際の基板への吐出プロセスに移行しても良い。また、実際の液滴付与工程では、吐出ヘッド７と基板１の距離は、前述のように１００μm～１０００μmと比較的狭く設定されること多いため、そのままの状態で前記ヘッド清掃工程及びヘッド観察工程を行なうのが困難な場合は、ヘッド或いはステージ側をＸ，Ｙ，及びＺのいずれかの方向に逃がすことで、前記ヘッド清掃工程及びヘッド観察工程を行っても良い。

【００５９】以上を踏まえ、画像形成装置を製造するには、先ず、絶縁性基板１を有機溶剤等で充分洗浄し乾燥させた後、スパッタ法～フォトリソグラフィー技術等を用いて素子電極２、３を形成する。次に、列方向配線１１、絶縁膜６ともう一方の素子電極と接続する行方向配線１０を順次形成する。

【００６０】次に、この基板を本発明における液滴付与装置のステージ８上に固定し、前記ヘッド表面清掃機構１３及びヘッド表面観察機構１４を用いて、ヘッド７（及びノズル９）の表面状態を安定に保ち、ステージ（或いはヘッド側）を移動しながら、素子膜４を形成する材料を含有した溶液の液滴１２を連続的に付与し、３００～４００℃で焼成することによって導電性薄膜４を形成する。

【００６１】その後、通電フォーミング工程として、素子電極２、３間に不図示の電源より通電を行ない、導電性薄膜４を局所的に破壊、変形もしくは変質させた電子放出部５を形成する。この電子放出部５は、素子膜４の一部に形成された高抵抗の亀裂である。

【００６２】また、通電フォーミングを終了した後、真空中に存在する有機物質に起因する炭素あるいは炭素化合物を導電性薄膜上に堆積させ素子電流Ｉｆ、放出電流Ｉｅを変化させるために、活性化工程と呼ぶ処理を施しても良い。

【００６３】このようにして形成された電子源基板をリアプレートとして用い、ガラス基板に蛍光膜が形成されたフェースプレートと支持枠等を用いてパネルを形成し、該パネル内部を真空に排気した後、封止して、画像表示パネルを構成する。

【００６４】更に、前記画像表示パネルに駆動回路等を接続して、図１に示すような画像形成装置を得ることができる。

【００６５】以上説明したように、本実施形態によれば、低コストで且つ容易に大面積に均一な素子電極及び導電性薄膜を正確且つ確実に形成し、均一な表面伝導型の電子放出素子を備えた電子源基板の製造、ひいては当該電子源基板を有する画像形成装置の製造が可能となる。

【００６６】

【実施例】以下、本発明の具体的な実施例を説明する。

【００６７】（実施例１）マトリクス状に配線及び素子電極を前述したような方法で形成した基板を用い、多数の表面伝導型電子放出素子を有する電子源基板を作製した。以下、図２～図４を参照にしながら表面伝導型電子放出素子の製造工程を説明する。

【００６８】１．絶縁基板１として９００×６００（mm）の青板ガラス基板を用い、有機溶剤等により充分に洗浄後、１２０℃で乾燥させた。該基板１上に、真空成膜技術及びフォトリソグラフィ技術を用いてＰｔからなる素子電極２、３を形成した。このときのＰｔの厚みを２００Å、素子電極２、３の距離を２０μmとした。

【００６９】２．次に、真空成膜技術及びフォトリソグラフィ技術を用いてＮｉからなる列方向配線１１を形成した。この時の配線幅を３００μm、厚さを５００Åとした。更に、真空成膜技術とフォトリソグラフィ技術及びエッチング技術を用いて、絶縁膜６を列方向配線１１上に形成した。絶縁膜６の厚さは５０００Åとした。その後、真空成膜技術及びフォトリソグラフィ技術を用いてＡｕからなる行方向配線１０を形成した。配線の幅は２００μm、厚さは５０００Åとした。

【００７０】３．その後、前記基板を本発明における液滴付与装置のステージ８に吸着し、パターンの位置合せ等を行った後、表面観察機構１４でヘッド７表面を観察したところ、乾燥による先端部の液不足が確認された。そこでヘッド清掃機構１３により清掃を行なった。実施条件は、真空吸引が０．２秒、ワイプ布として、ルビセル（商品名）を用い、接触荷重２００ｇ，移動速度４０mm／秒で清掃した後、捨て吐出領域１７にて０．５秒間の捨て吐出を行い、再度、前記表面観察機構１４を用いてヘッド表面を観察した。先端部の液不足は解消されており、表面の傷の発生や異物の付着等の異常が無いことを確認した。その後、素子膜４を形成する材料を含有した溶液の液滴１２を付与した。溶液としては、有機パラジウム含有溶液（酢酸Ｐｄ－モノエタノールアミン錯体０．４ｗｔ％、イソプロピルアルコール２０％、エチレングリコール１．０％、ポリビニルアルコール０．０５％の水溶液）を使用した。この時のステージのスキャ

ンスピードは３００mm／秒であり、液滴の吐出速度は約１０m／秒だった。さらに３００℃で１０分間の加熱処理を行って、膜厚１００Åの酸化パラジウム（ＰｄＯ）微粒子からなる導電性薄膜４を形成した。

【００７１】４．更に、電極対２，３の間に電圧を印加し、導電性薄膜４を通電処理（通電フォーミング）することにより、電子放出部５を形成した。

【００７２】こうして作製された電子源基板に、フェースプレート、及び支持枠等を組み合わせて表示パネルを作製し、更に、駆動回路を接続して画像形成装置を作製した。

【００７３】本実施例の製造方法により以上の如く作製した電子放出素子は、素子膜を形成する液滴の吐出が安定しているため、フォーミング前の素子電極２，３間の素子膜の形状及び抵抗値のばらつきが小さい。このため、素子膜に均一に電流が流れ、亀裂が一様に形成され、また電子放出素子にも均一に電流が流れ素子特性のばらつきは少なく、良好な画像形成装置を歩留まりよく得ることができた。

【００７４】（実施例２）本実施例では、実施例１とは別の種類の吐出ヘッドを用い、複数ノズルを同時に使用した。この吐出ヘッドでは、１つのヘッドに６４個の吐出ノズルが設けられており、このうちの４個のノズルを同時に使用しながら、実施例１と同じ方法により電子源基板を作製した。清掃条件は、実施例１と同じとした。本実施例では、吐出の安定を崩すこと無く、製造タクトを約１／４に短縮できた。更に実施例１と同じ方法で電子放出素子を製造したところ、良好な画像形成装置を歩留まりよく得ることができた。

【００７５】（実施例３）本実施例では、実施例２と同様の方法を用い、実施例２で使用した種類のヘッド２個の各４ノズルを同時に使用しながら、実施例２と同じ方法により電子源基板を作製した。清掃条件は、実施例１と同じとした。更に、この条件で、連続して５０枚の電子源基板を製造したところ、すべての基板にわたって安定した吐出が得られた。なお、５０枚製造時のヘッドの清掃回数合計は、吐出位置合せ等を含め、約１００回だった。

【００７６】更に、これらの電子源基板を用いて実施例１と同様の方法で電子放出素子及び画像形成装置を製造したところ、良好な画像形成装置を短時間で歩留まりよく得ることができた。

【００７７】（実施例４）図５は、実施例４において作製される電子源基板を示す模式図である。ここでは、導電性薄膜４の他に素子電極２、３を本実施形態における製造方法で作製した。

【００７８】１．絶縁基板１として９００×６００（mm）の青板ガラス基板を用い、これを有機溶剤等により充分に洗浄後、１２０℃で乾燥させた。該基板１上に真空成膜技術及びスクリーン印刷法を用いてＮｉからなる列方向配線１１を形成した。このとき配線の幅を３００μm，その厚みを５００Åとした。さらに同様に厚さ５０００Åの絶縁膜６を行方向配線１１上に形成した後、同様にＡｕからなる行方向配線１０を形成した。配線の幅は２００μm、厚さを５０００Åとした。

【００７９】２．絶縁基板１を本発明における液滴付与装置のステージ８に吸着し、実施例１と同様に表面観察機構１４、ヘッド清掃機構１３を使用しながら素子膜４を形成する材料を含有した溶液の液滴１２を付与した。溶液としては、有機パラジウム含有溶液（酢酸Ｐｄ－モノエタノールアミン錯体０．４ｗｔ％、イソプロピルアルコール２０％、エチレングリコール１．０％、ポリビニルアルコール０．０５％の水溶液）を使用した。この時のステージのスキャンスピードは５００mm／秒、液滴の吐出速度は約１０m／秒だった。

【００８０】３．更に、絶縁基板１に対して１００℃で５分間の加熱処理を行った。

【００８１】４．次に、同様に、絶縁基板１上に有機白金含有溶液（（酢酸白金－モノエタノールアミン錯体０．４ｗｔ％、イソプロピルアルコール２０％、水８０％）を用い、素子電極２を列方向配線１１に接続するように形成した後、続いて、この素子電極２から１２０μmずらした位置に行方向配線１０と接続するように素子電極３を形成した。

【００８２】５．更に、絶縁基板１に対して３００℃で１０分間の加熱処理を行って、膜厚１００Åの酸化パラジウム（ＰｄＯ）微粒子からなる導電性薄膜４、及びＰｔからなる素子電極２、３を形成した。素子電極２，３はギャップ間隔を２０μm，電極の幅を３１０μm、その厚さが３００Åに制御した。

【００８３】６．更に、素子電極２，３の間に電圧を印加し、導電性薄膜４を通電処理（通電フォーミング）することにより、電子放出部５を形成した。

【００８４】こうして作製された電子源基板に、フェースプレート、及び支持枠等を組み合わせて表示パネルを作製し、更に、駆動回路を接続して画像形成装置を作製した。その結果、実施例１と同様の良好な画像形成装置を得ることができた。

【００８５】

【発明の効果】本発明によれば、吐出不良や着弾位置ずれによる素子電極及び素子膜の形成不良の発生を防ぐことが可能になり、均一な素子電極及び素子膜を歩留まり良く製造することができ、大面積基板全面に対して良好な素子特性をもつ電子源基板を歩留まり良く、且つ低コストで製造することが可能となる。

【図面の簡単な説明】

【図１】本実施形態により製造される画像形成装置の主要構成を示す概略斜視図である。

【図２】表面伝導型電子放出素子の構成を示す模式図である。

【図３】本実施形態の製造方法に用いる液滴付与装置を示す模式図である。

【図４】液滴付与装置の清掃機構の一例を示す模式図である。

【図５】一実施例において作製される電子源基板を示す模式図である。

【図６】従来の表面伝導型電子放出素子を示す模式図である。

【図７】従来の金属含有溶液を基板上に吐出して一対の素子電極及び導電性薄膜を形成する液滴付与装置を示す模式図である。

【符号の説明】

１　基板

２，３　素子電極

４　導電性薄膜

５　電子放出部

６　絶縁膜

７　吐出ヘッド

８　基板ステージ

９　吐出ノズル

１０　列方向配線

１１　行方向配線

１２　液滴

１３　ヘッド清掃機構

１４　ヘッド表面観察機構

１５　吸引パッド

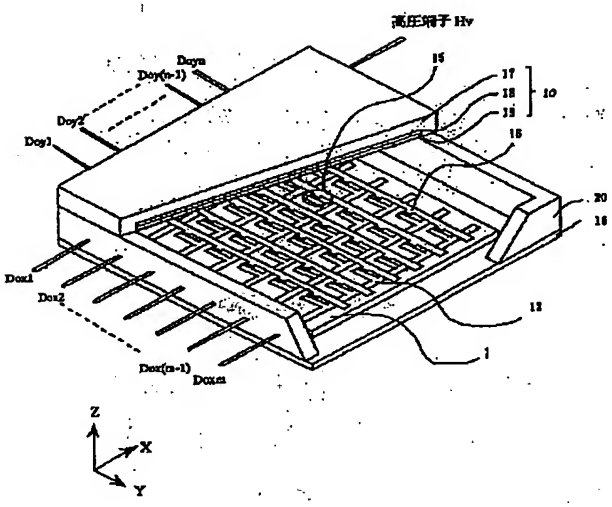
１６　ワイプ布

１７　捨て吐出領域

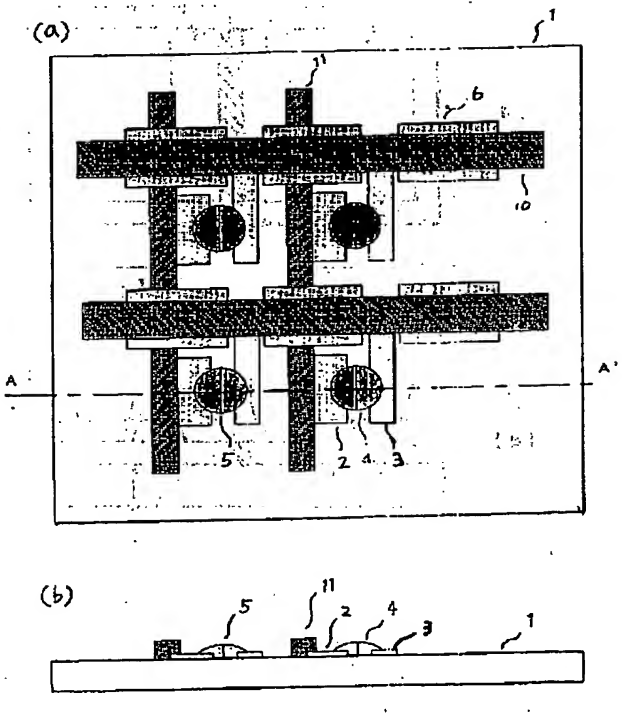
１８　小型ＣＣＤカメラ

１９　観察用モニター

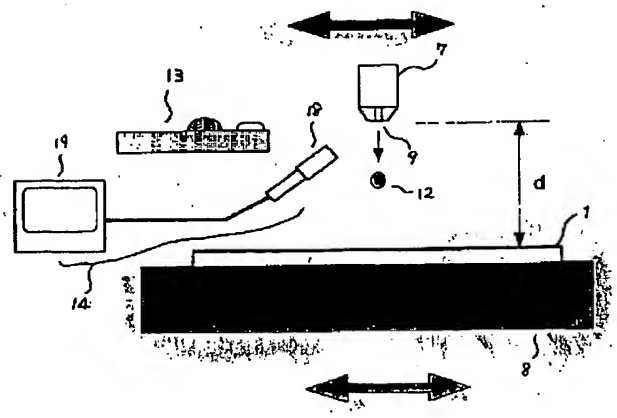
【図１】



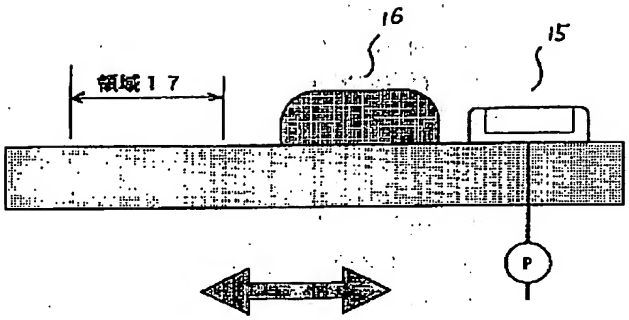
【図２】



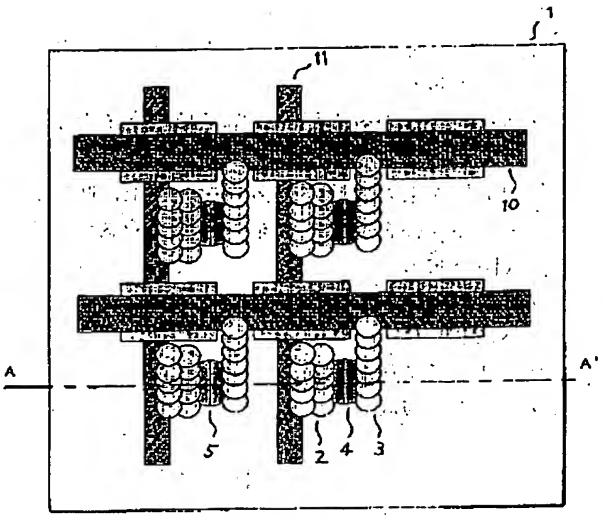
【図３】



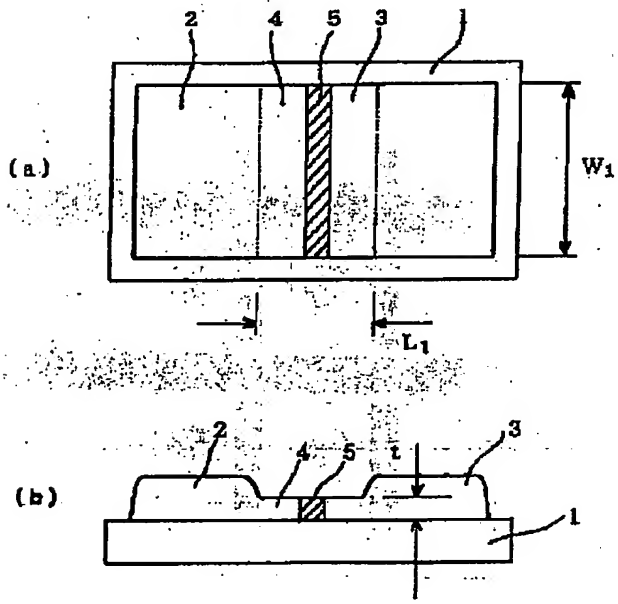
【図４】

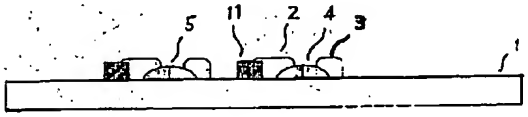


【図５】



【図６】





【図７】